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Comparative Analysis Of Sensilla On Antennae And Mouthparts Of Larvae In Two Species Of Ditrysian Moths (Lepidoptera)

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Abstract

Systematics encompasses two more narrowly defined but highly interdependent fields. The first is taxonomy and the second field is phylogenetics. In modern systematics, taxonomy aims to reflect evolutionary history. The morphological traits of immature stages remain largely unresolved for a vast majority of the lepidopteran species worldwide, although they have potential to be applied in lepidopteran classification and systematic studies. The larval instars in Lepidoptera are signature examples of agricultural pests. The present study deals with SEM investigation of ultrastructure of different instars of two lepidopteran pest species i.e., *Somena scintillans* Walker 1856 and *Trabala vishnou* Lefebvre 1827. These findings will not only help in enriching taxonomic database but will also act as an aid for future studies aimed at devising pest control methods.

Keywords: larvae, lepidoptera, antenna, mouthparts, sensilla, scanning electron microscopy

1. Introduction

Lepidopterans can occur in various habitats but their immature stages are usually associated with terrestrial habitats. The larval stages are eruciform type, voracious feeders and bear chitinized semi-circular head capsule. Head possesses antennae and mouthparts which help in perceiving stimulus from environment. Both these structures bear chemosensory structures called sensilla which are responsible for survival of larvae. Sensilla are the smallest functional units of insect sensory system and form an essential interface between the external and internal sensory environments of insects (Keil 1999**;** Shields & Hildebrand 2001). They subsequently regulate different responses and behaviours of insects via nervous system (Zhang *et al.* 2013). Insect behaviour can be best understood with electrophysiological studies but results of this technique needs to be correlated with insect sensilla and there is lack of information available on its morphology. The present study is carried out with the aim to fill that gap and subsequently to enrich the taxonomic data available for better identification of species at the level of immatures. Their comparative analysis will help providing a foundation for further electrophysiological, evolutionary studies and phylogenies reconstruction. Both the species i.e., *Somena scintillans* Walker 1856, the yellow tail tussock moth and *Trabala vishnou* Lefebvre 1827, rose-myrtle lappet moth referable to ditrysian families Erebidae and Lasicocampidae are polyphagous pests and usually found on infested pomegranate fruits and apple orchard plants respectively. In larvae of *Somena scintillans*, black tufts of hair are present all over the body. The creamy white lines are present on lateral sides of abdomen and thoracic segments are light brown in color. It has a pair of orange spots along the dorso-lateral side of the thorax and

abdomen through which tuft of irritant hair arises. In larvae of *Trabala vishnou*, yellow head is with red spots and brownish grey body with long lateral tufts on each somite. The anterior tufts are reddish brown in color and long black hair arise along with tufts.

2. Materials and Methods

2.1 Identification and preservation

The eggs were collected from different localities of district Kullu in Himachal Pradesh, India (31°57′36″N, 77°6′0″E, 1279m) and further reared from first instar to adult stage in semi natural conditions according to protocol stated by Goncalves *et al.* 2020**.** The adults were preserved for identification purpose and identification was done on the basis of external morphological characters and comparison with the identified collections present in Lepidoptera Lab, Punjabi University, Patiala.

2.2 Scanning electron microscopy

For SEM studies, methodology adopted by Kaleka *et al.* (2023) was followed. The head of each larval instar was separated and placed in Carnoy's fixative solution (95% ethanol and glacial acetic acid with ratio of 3:1) for 3 hours in case of first 3 instars and for 12 hours for later instars and then kept in 2.5% glutaraldehyde at 4°C for 2 hours in case of initial 3 instars and overnight for later instars. The sample was cleaned in a phosphate buffer solution on the following day. The sample was then dehydrated through a graded ethanol series of 30, 50, 70, 80 and 90% (for 15 min each), then fully dehydrated in 100% ethanol (three times for 30 minutes each) and lastly cleaned in isoamyl acetate (three times for 10 minutes each). The samples was air dried for 1 hour before performing Scanning Electron microscopy.

Different aged instars were also preserved in glass vials containing 70% alcohol and glycerol in the ratio of 8:2. The prepared sample was examined and photographed for ultrastructure studies under scanning electron microscope (JEOL) JSM-6100 in the Instrumentation Centre, Punjabi university, Patiala, India.

2.3. Analysis

The sensilla were identified from SEM micrographs on the basis of terminologies proposed by Schneider (1964), Zacharuk (1980, 1991) and Grimes (1986a, 1986b). The images were labelled using Adobe Photoshop CS4 software. Metric analyses were performed taking at least three measurements for each sensilla and summarising the results to get mean average and standard deviation using ImageJ software.

3. Results

3.1 *Somena scintillans* Walker 1856 (Figs. 1-5)

First instar

Antenna

Antenna consists of typical three segments found in immature stages: scape, pedicel and flagellum. Pedicel is somewhat deeply seated inside scape. Scape reports no evident sensilla. Pedicel has three basiconica sensilla (B1-B3) and two sensilla chaetica (C1-C2). B3 is smallest among these basiconica sensilla. Sensillum C1 is longer than sensillum C2. Flagellum has four basiconica sensilla (B4-B6) and one sensillum styloconicum (Sty) with a socket. Sensillum B4 is tallest among these three sensilla on flagellum and faces sensillum styloconicum.

Mouthparts

Labrum is a broad structure with notched anterior margin covering the mandibles. There are 6 pairs of sensilla chaetica on surface of labrum. Mandibles have dentitions and in this case only two teeth of left mandible are visible. On each mandible, two sensilla chaetica are present. Maxillae consist of cardo, stipes, galea and a maxillary palp. Galea bears 3 sensilla trichodea (ST1-ST3), 2 sensilla styloconica (LSS and MSS) and one small central sensillum basiconicum (CSB). Cardo and stipe each have one sensillum chaeticum. Maxillary palp bears total 8 sensilla on its distal end and one inverted U shaped sensillum digitiformium (SD) on its lateral side. Among 8 distal sensilla, three are apical basiconica sensilla (A1-A3), three lateral basiconica sensilla (L1-L3) and two medial basiconica sensilla (M1-M2).

Second instar

Antenna

Antenna with all three segments occurs in second instar as well. No evident sensilla on scape and all the sensilla are distributed on later two segments. Pedicel bears three sensilla basiconica (B1-B3) and two sensilla chaetica

(C1-C2). B3 is the smallest sensilla of second segment. Flagellum also has three basiconica sensilla (B4-B6) and one sensillum styloconicum (Sty). Sensillum B6 is smallest sensilla among all sensilla basiconica of this final segment.

Mouthparts

Labrum presides over mandibles and has 6 pairs of sensilla chaetica. Second instar onwards, mandibles have outgrown labrum and all its teeth are visible. There are total 5 teeth on the margin of mandibles. Sensilla chaetica of mandibles are not visible. Galea has three elongated sensilla trichodea (ST1-ST3) with pointed ends, two sensilla styloconica (LSS-MSS) with cylindrical base and small protuberance of central sensillum basiconicum (CSB). A single sensillum chaetica is present on each cardo and stipe. Maxillry palp has 8 sensilla basiconica on its tip (A1-A3, L1-L3 and M1-M2) and 1 sensillum digitiformium (SD).

Third instar

Antenna

Antenna has three segments: scape, pedicel and flagellum. Pedicel here is not in a deep pocket of scape. Pedicel bears three basiconica sensilla (B1-B3) and two sensilla chaetica (C1-C2). C1 is longer than C2. Flagellum has three sensilla basiconica (B4-B6) and one sensillum styloconicum (Sty). Sensillum B1 lies on left side of B4. Basiconica sensilla are all conical in shape with blunt ends whereas styloconicum has a narrow pointed end with a socket in which it is embedded. Sensillum B4 faces sensillum styloconicum.

Mouthparts

Labrum or upper lip has a clear V shaped fringe partition at its anterior end and 6 pairs of sensilla chaetica on its surface. Mandibles lie closed and retrieved underneath labrum. Each mandible has two sensilla chaetica (C1-C2) and sensillum C1 is longer than sensillum C2. Galea bears total 6 sensilla as in the preceding instars. These are sensilla trichodea ST1-ST3, two sensilla styloconica (LSS-MSS) and one basiconicum (CSB). Sensillum LSS doesn't have a swollen base here and a mere protuberance is observed. Maxillary Palp has 8 basiconica sensilla and one sensillum digitiformium (SD).

Fourth instar

Antenna

There are total 9 sensilla distributed on last two segments of antenna. Scape has no evident sensilla. Pedicel has total 5 sensilla. There are three large basiconica sensilla and two sensilla chaetica. B3 is shortest. Flagellum has three basiconica sensilla as well (B4-B6) and one senillum styloconicum (Sty).

Mouthparts

Labrum bears 6 pairs of sensilla chaetica and is having prominent bifurcation of its anterior margin. Bifurcation is here rather U shaped and not as sharp as in the preceding instar. Only three mandible teeth are visible, other two lie concealed. Mandibles have two sensilla chaetica each. Galea shows similar arrangement and distribution. Similar sensilla distribution observed on galea, cardo stipe and maxillary palp as in previous instars. Galea has three sensilla trichodea (ST1-ST3), two sensilla styloconica (LSS-MSS) and one central sensillum basiconicum (CSB). Both LSS and MSS here have prominent bases. Maxillary palp has similar sensilla pattern as observed in earlier instars.

Fifth instar

Antenna

Antenna of fifth instar possesses total 8 sensilla, only B3 sensillum of second segment is not observed and remaining are present on same respective positions. B6 is smallest among basiconica sensilla of final segment in case of final instar as well.

Mouthparts

Labrum has a roughly U shaped boundary at interior margin and no sharp notch. Labrum possesses 6 pairs of sensilla chaetica. Mandibles have 2 pairs of sensilla chaetica and three of its teeth are visible. Galea is with 6 sensilla ST1 ST2, ST3, LSS, MSS and CSB. Maxillary palp is two segmented. The second segment on its lateral side has inverted U-shaped sensillum digitiformium (SD) and all 8 sensilla basiconica are present on the terminal end of palp.

3.2 *Trabala vishnou* Lefebvre 1827 (Figs. 6-10)

First instar

Antenna:

Antenna is divisible into three segments: scape, pedicel and flagellum. Pedicel has a wavy pattern on its entire surface. Sensilla are present on last two segments, scape without any sensilla. Second segment or pedicel has total 4 sensilla, two sensilla basiconica (B1-B2) and two sensilla chaetica (C1-C2). B2 is longer than B1and both are conical in shape with blunt ends. C1 is clearly longer than C2 and distinguishable from sensilla basiconica because of their blunt ends. Sensillum B3 of second segment is absent. Final segment of antenna bears 4 sensilla: 3 sensilla basiconica (B4-B6) and one senillum styloconicum (Sty). Among sensilla basiconica of second segment, B4 is longest and faces sensillum styloconicum (Sty). B5-B6 are present on either sides of B4, B5 being longer than B6.

Mouthparts:

Labrum is a broad structure with a typical notch towards its end and has 6 pairs of sensilla chaetica distributed all over it. Mandibles are well sclerotized and stout structures with some portion covered under labrum and total 3 teeth are visible. Each mandible is with 2 sensilla chaetica- C1-C2, C1 being longer than C2. Maxillae consist of three parts: cardo, stipes, galea and a maxillary palp. Both cardo and stipe have single sensillum chaeticum each. Galea bears three sensilla trichodea (ST1-ST3) and two sensilla styloconica i.e., lateral sensilla styloconica and medial sensilla styloconica (LSS and MSS). Protuberances of LSS and MSS are with blunt ends. Central sensilla basiconica (CSB) is absent on galea. Maxillary palp has similar wavy pattern on its surface as observed on the surface of second antennal segment and its distal segment is bearing 8 sensilla basiconica with rounded blunt ends namely 3 apical (A1-A3), 3 lateral (L1- L3) and 2 medial sensilla basiconica (M1 and M2), 1 sensillum digitiformium (SD) and 1 sensillum campaniformium (SC) on its lateral surface. Labium has a pair of labial palps and an elongated tube like spinneret (Spi). Each labial palp bears one sensillum styloconicum and one sensillum chaeticum, both sensilla with pointed ends.

Second instar

Antenna:

Antenna with all three segments occurs in second instar as well. Scape bears no sensilla and a total of 7 sensilla adorn the rest two segments i.e., pedicel and flagellum. Pedicel has two large sensilla basiconica (B1-B2) and two sensilla chaetica (C1-C2), C1 being longer than C2 and B2 being longer than B1. Sensillum B3 is absent. Flagellum bears total three sensilla, two sensilla basiconica (B4-B5) and one sensillum styloconicum (Sty). Small basiconic sensillum B6 is not visible.

Mouthparts:

Mouthparts consist of a typical notched labrum bearing 6 pairs of sensilla chaetica. Mandibles are well sclerotised and all five teeth are visible on its outer edge in this particular instar. Mandibles also bear a group of sensilla chaetica. Maxillae consist of cardo, stipes, galea and a maxillary palp. Stipe and cardo are connected and galea arises from cardo bearing 1 sensillum chaeticum (C), three sensilla trichodea (ST1-ST3), two sensilla styloconica (lateral and medial). Central sensillum basiconicum i.e., CSB is absent here. Maxillary palp bears sensilla on its distal segment. Total 8 sensilla basiconica (three Apical, two medial and three lateral) are present on its tip and well surrounded by an apical ridge. Apical sensillum A1 lies in the middle and forms the reference point for identification of other basiconic sensilla. Sensillum A1 forms triangular structure with other two apical sensilla (A2 and A3). The ventro-anterior surface of segment facing mandibles bears no sensilla. A pair of labial palps bearing spinneret (Spi) is present. Spinneret here is broader as compared to sleek spinneret of first instar. Each labial palp has one sensillum chaeticum (C) and one sensillum styloconicum (Sty) each.

Third instar

Antenna:

It has three segments, sensilla present on only later two segments. Pedicel has two large sensilla basiconica (B1-B2) and two sensilla chaetica (C1-C2), C1 longer than C2 and B2 shorter than B1. Sensillum B3 is absent. Flagellum has total four sensilla, three sensilla basiconica (B4-B6) and one sensillum styloconicum (Sty). B4 is longest among sensilla basiconica of this segment and lies opposite to sensillum styloconicum, sensillum B6 longer than B5.

Mouthparts

These parts consist of labrum with a notch in its middle and a pair of mandibles which have grown large enough and all 5 dentitions of mandibles are visible in third instar. The group of sensilla chaetica on each mandible are visible. Maxillae consist of cardo and stipe. Each galea has 3 sensilla trichodea (ST1-ST3) and two sensilla styloconica (lateral and medial). Central sensillum basiconicum is absent here as well. The distal segment of Maxillary palp has 8 sensilla basiconica with sensillum A1 in alignment with sensillum digitiformium (SD). 2 sensilla campaniformia (SC1-SC2) are present in close proximity with SD. A pair of labial palps is present, each palp bearing single sensillum styloconicum (Sty) and single sensillum chaeticum (C) and a spinneret (Spi), which is broad in shape.

Fourth instar

Antenna

The antenna is with three segments: scape, pedicel and flagellum. Scape lacks any type of sensilla but has a distinguishable rhomboid scaly pattern. 8 sensilla are distributed over pedicel and flagellum. Pedicel possesses 2 sensilla chaetica (C1-C2), C1 being longer than C2 and two large sensilla basiconica (B1-B2). B1 is longer than B2 and sensillum B3 absent. Flagellum, the last segment has 4 sensilla of two types i.e., 3 small sensilla basiconica (B4-B6) and one sensillum styloconicum with a distinguishable socket. Sensillum B4 faces styloconicum sensillum.

Mouthparts

Mouthparts consist of a labrum adorned with 6 pairs of sensilla chaetica and a pair of mandibles with several chaetica on each mandible. 4 teeth are visible and one set remains covered under labrum. Galea, like those in previous instars has 3 sensilla trichodea (ST1-ST3) and sensilla styloconica with medial styloconic sensilla i.e. MSS being the one near to maxillary palp. The distal segment of maxillary palp has group of 8 sensilla basiconica on its tip with A1 being the tallest among apical sensilla. A pair of labial palps and spinneret (Spi) are also present in this instar and each labial palp bearing single sensillum styloconicum (Sty) and single sensillum chaeticum (C).

Fifth instar

Antenna

The antenna of final instar as well has total 8 sensilla distributed over two segments i.e., pedicel and flagellum. The pattern of scales is clearly visible as a prominent character for identification. Pedicel has total 4 sensilla of two types i.e., two sensilla chaetica (C1-C2) and two large sensilla basiconica (B1-B2). C1 is longer than C2 and B1 being longer than B2. Sensillum B3 is absent here as well. Flagellum has three small sensilla basiconica (B4-B6) and one sensillum styloconicum (Sty). Sensillum B4 is long with blunt end, whereas sensilla B5 and B6 are not elongated ones and rather blunt protuberances. B5 is shorter than B6 and also shortest among all basiconica sensilla of final segment.

Mouthparts

Labrum with its typcal structure possesses 6 pairs of sensilla chaetica. Mandibles bear several sensilla chaetica on its surface and mandible teeth are not clearly visible. Galea bears three pointed and long sensilla trichodea (ST1-ST3) and 2 styloconic sensilla. Maxillary palp has its distinctive pattern with 8 basiconic sensilla well surrounded by an apical ridge. Sensillum A1 is longest among these basiconic sensilla. A pair of labial palps and spinneret is present with single sensillum chaeticum and single sensillum styloconicum on each of the palp. Spinneret (Spi) is a stout and blunt structure.

4. Discussion

During present study, it has been observed that the antennae are three segmented and no sensilla are found on basal scape in all instars in both these species. The pedicel possesses three sensilla basiconica and two sensilla chaetica in *Somena scintillans* Walker as present *Carposina sasakii* Matsumura 1898 (Liu *et al.*, 2011) and *Homoeosoma nebulella* Denis and Schiffermuller 1775 (Faucheux, 1995), even though the morphological appearance of these sensilla are different. But in case of *Trabala vishnou* Lefebvre 1827, only two sensilla basiconica and two sensilla chaetica are observed on second and final segment respectively. The antennal sensilla in Lepidopteran larvae are believed to display olfactory, contact-chemosensory, mechano-sensory and thermos-sensory functions with basiconica sensilla to be specifically olfactory in nature (Faucheux, 1995).

Sensilla chaetica are considered tactile in nature whereas styloconica as thermos-sensory (Schoonhoven, 1967). It is supposed that the sensilla in both species under reference have similar functions here as well.
The labrum bears six pairs of sensilla chaetica in both species and these results coincide with previous findings reported. (Song *et al.,* 2014; Men *et al.,* 2016; Yiping *et al.,* 2018). The sensilla chaetica are described to be mechanical in nature (Davis *et al.,* 2008; Kent and Hildebrand, 1987; Nielsen and Kristensen, 1989). The mandibles are dentate and bear one pair of sensilla chaetica in *Somena scintillans* Walker 1856 and multiple pairs of sensilla chaetica in *Trabala vishnou* Lefebvre 1827. The major variations are observed in case of maxillae. Each galea has three senilla trichodea, two large sensilla styloconica in both these species. One central sensillum basiconicum is observed in all stages of *S. scintillans* Walker, but found only in last two instars of *T. vishnou* Lefebvre 1827. Each maxillary palp has eight sensilla basiconica on their distal end. Ma (1972, 1976) and Albert (1980) reported these sensilla gustatory, mechanical and olfactory in nature. In both species, each labial palp bears conical sensillum chaeticum and elongate sensillum styloconicum on its distal end in all the instars and are thought to be mechanoreceptors on the basis of available literature on electrophysiological studies **(**Albert, 1980; Devitt and Smith, 1982; Faucheux, 1995).
During present study, significant difference have been observed in both these species. Such findings will help in species delimitation at initial level of their life histories and further strengthen the morpho-taxonomy at the level of immature stages. All the significant observations and metrical analysis for sensilla present on different head structures of both these species are summarised in respective tables **(Table 1-4**). Such identification is desired as its the immatures which destroy the crops and need to be targeted with specific pest control methods. Such studies will further provide an aid for future electrophysiological studies for understanding behavioural mechanisms of pests and designing such pest control methods as well as for reconstruction of phylogenies.

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TABLE 1: METRICAL ANALYSIS OF SENSILLA OF ANTENNAE OF DIFFERENT AGED INSTARS OF *Somena scintillans* (represented as mean length±SD micrometers)

Sensilla type	1st instar	2nd instar	3rd instar	4th instar	5th instar
B1	13.32±0.60	20.97±0.17	24.86±0.52	25.50±0.70	32.69±0.67
B2	17.53±0.32	11.09±0.44	14.78±0.54	20.14±0.45	12.84±0.10
B3	5.08±0.33	5.66±0.37	3.38±0.57	6.01±1.44	Not visible
B4	10.12±0.08	9.62±0.19	15.24±0.32	11.58±1.15	20.46±0.39
B5	5.90±0.31	3.65±0.19	4.47±0.52	4.08±0.52	7.80±0.29
B6	3.92±0.33	3.27±0.27	3.97±0.5	6.67±0.36	4.12±0.07

TABLE 2: METRICAL ANALYSIS OF MOUTHPARTS AND ITS SENSILLA OF DIFFERENT AGED INSTARS OF *Somena scintillans* (represented as mean length±SD micrometers)

NAME OF STRUCTURES	1st instar	2nd instar	3rd instar	4th instar	5th instar
Distal segment of Mxp	15.93±0.36	10.15±0.13	24.17±0.18	18.46±0.39	33.18±1.32

Galea					
ST1	7.97±.39	14.02±0.09	16.36±0.32	26.34±0.49	24.06±0.33
ST2	7.98±0.62	17.53±0.68	9.24±0.53	31.42±0.56	23.71±0.52
ST3	10.12±0.46	22.81±0.83	15.90±0.52	21.97±14.64	36.55±3.11
Sensilla of Maxillary Palp					
A1	3.60±0.12	2.97±0.06	4.54±0.31	1.85±0.11	5.73±0.11
A2	2.48±0.07	3.54±0.15	2.92±0.17	1.64±0.16	3.21±0.27
A3	3.54±0.24	2.58±0.05	5.82±0.14	1.50±0.11	2.54±0.05
L1	2.35±0.34	3.04±0.28	2.80±0.14	1.61±0.07	3.07±0.07
L2	1.83±0.12	1.36±0.13	2.32±0.13	1.76±0.21	3.77±0.06
L3	2.09±0.19	2.47±0.26	2.84±0.13	1.78±0.13	2.43±0.07
M1	2.65±0.19	1.53±0.07	3.01±0.19	1.11±0.07	1.46±0.20
M2	1.98±0.03	2.58±0.14	3.6±0.14	1.77±0.09	2.45±0.25
Sensilla of Labial palp					
C	5.75±0.82	5.14±1.85	8.14±0.10	9.95±0.09	10.64±0.09
Sty	15.50±0.95	11.33±0.55	12.56±0.11	25.52±0.19	34.91±0.62

TABLE 3: METRICAL ANALYSIS OF SENSILLA OF ANTENNAE OF DIFFERENT AGED INSTARS OF Trabala vishnou (represented as mean length±SD micrometers)

Sensilla type	**1st instar**	**2nd instar**	**3rd instar**	**4th instar**	**5th instar**
B1	13.35±0.39	19.49±0.21	22.20±0.38	25.66±0.71	18.433±1.21
B2	14.47±0.19	19.85±1.41	22.12±0.80	17.28 ±1.48	11.47±0.27
B3	Absent	Absent	Absent	Absent	Absent
B4	14.81±0.28	19.28±0.43	9.96±0.21	77.64±12.01	18.46±1.16
B5	4.51±0.63	3.58 ±0.15	1.17±0.28	2.98±0.59	3.78±0.08
B6	5.94±0.13	Not visible	2.08±0.15	2.51±0.28	4.83±1.00

TABLE 4: METRICAL ANALYSIS OF MOUTHPARTS AND ITS SENSILLA OF DIFFERENT AGED INSTARS OF *Trabala vishnou* (represented as mean length±SD micrometers)

NAME OF STRUCTURES	**1st instar**	**2nd instar**	**3rd instar**	**4th instar**	**5th instar**
Labrum	88.94±5.43	97.07±11.10	119.89±10.71	170.49±3.64	229.42±4.73
Distal segment of Mxp	20.50±0.07	29.96±2.37	25.87±3.36	43.22±3.63	49.65±2.78
Galea					
ST1	19.455±0.91	33.11±2.75	87.51±2.86	81.48±2.82	121.62±1.01
ST2	16.01±0.62	36.49±2.18	87.63±1.13	71.94±1.23	120.91±1.68
ST3	18.91±0.63	35.15±2.86	75.54±3.78	86.66±2.87	116.88±1.95

Sensilla of Maxillary Palp					
A1	4.95±0.25	2.62±0.48	6.188±0.28	6.78±0.48	8.90±0.29
A2	4.72±0.14	2.11±0.2	5.04±0.44	5.34±0.60	8.78±0.12
A3	4.05±0.25	2.24±0.35	3.19±0.07	3.04±0.04	7.37±0.71
L1	3.37±0.07	2.8±0 0.46	3.62±2.42	4.13±0.16	4.99±0.13
L2	4.29±0.20	3.56±0.14	3.87±0.02	5.27±0.19	6.12±0.15
L3	3.66±0.07	3.23±0.34	5.35±0.03	5.12±0.16	5.65±028
M1	4.62±0.26	2.54±0.25	1.80±0.20	3.46±0.13	5.89±0.37
M2	3.31±0.12	3.12±0.35	4.89±0.33	4.46±0.58	7.33±0.22
Sensilla of Labial palp					
C	25.09±0.76	24.25±2.25	40.74±0.13	56.73±0.52	57.94±0.92
Sty	45.93±1.79	36.91±3.58	67.25±1.22	59.60±0.48	64.38±1.49

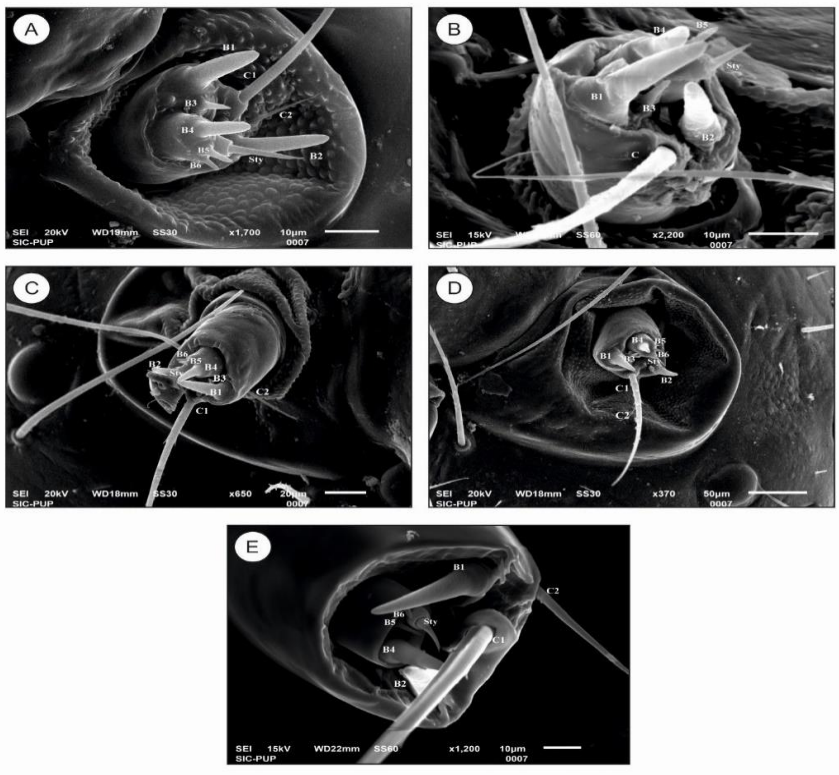

FIG. 1 : Morphology and structure of sensilla on antennae in all larval instars of *Somena scintillans*
(A) antenna of first instar (B) antenna of second instar (C) antenna of third instar
(D) antenna of fourth instar (E) antenna of fifth instar

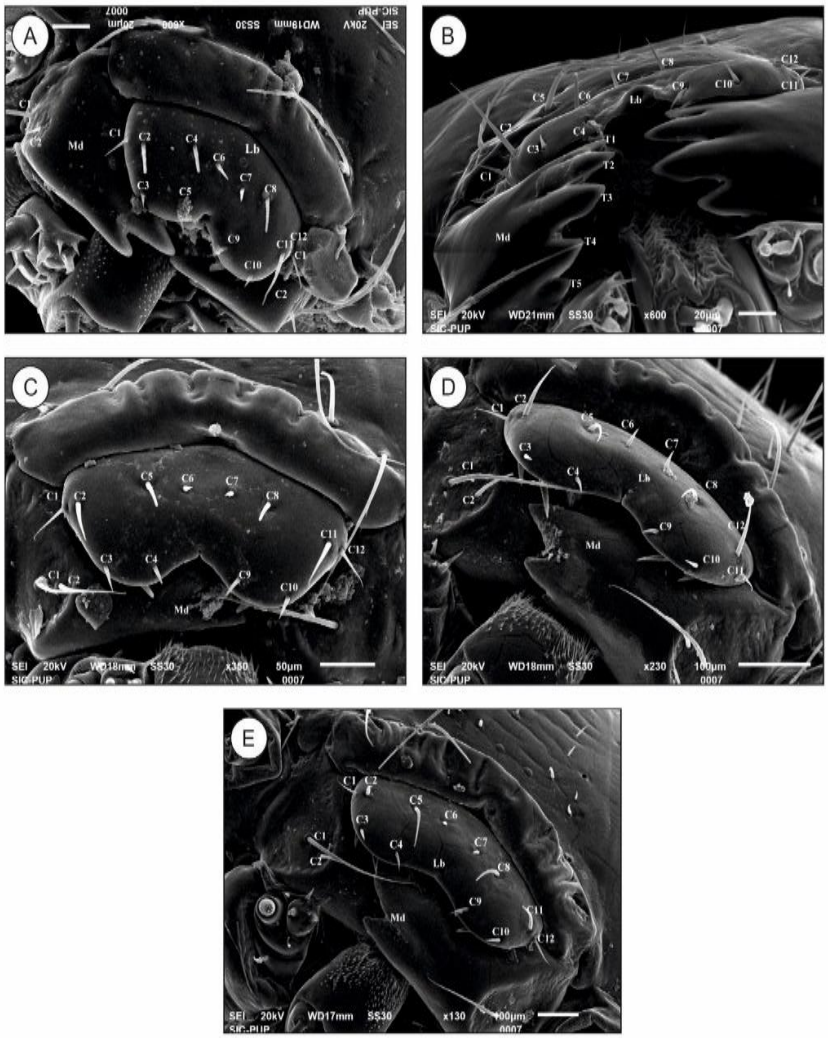

FIG. 2 : Morphology and structure of sensilla on labrum and mandibles in all larval instars of *Somena scintillans*
(A) labrum and mandibles of first instar (B) labrum and mandibles of second instar (C) labrum and mandibles of third instar
(D) labrum and mandibles of fourth instar (E) labrum and mandibles of fifth instar

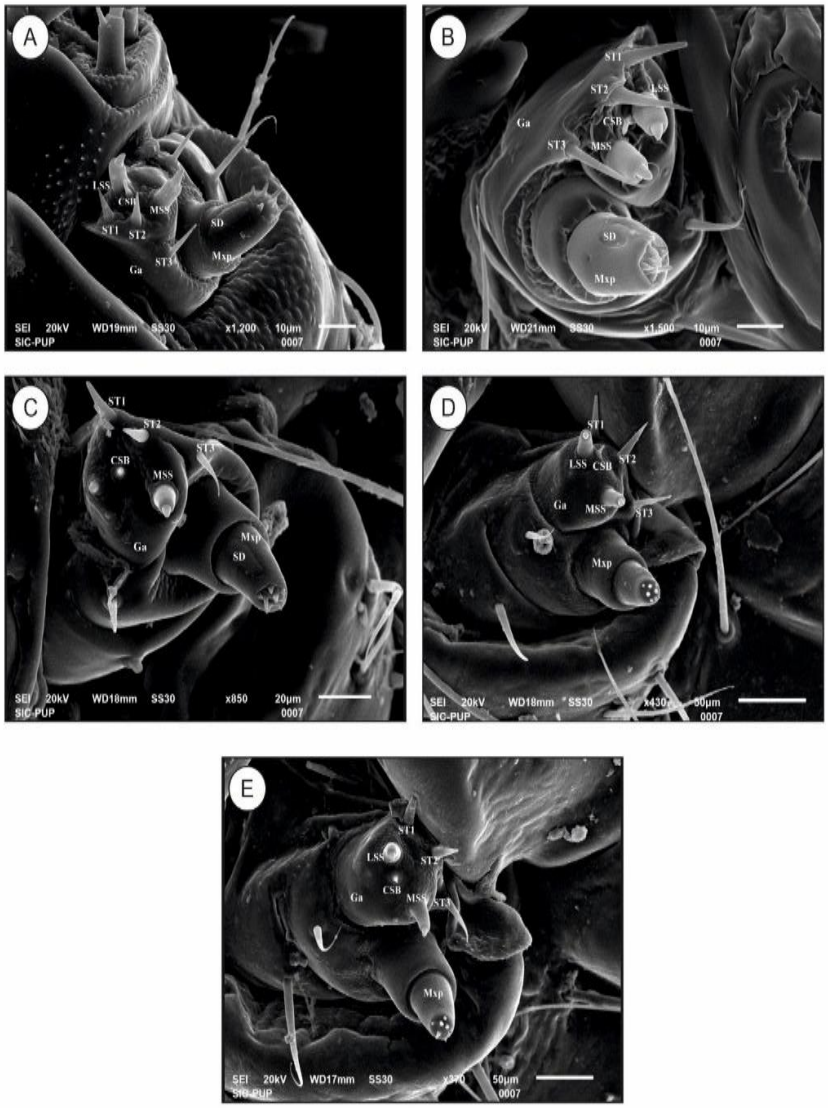

FIG. 3 : Morphology and structure of sensilla on galea in all larval instars of *Somena scintillans*
(A) galea of first instar (B) galea of second instar (C) galea of third instar
(D) galea of fourth instar (E) galea of fifth instar

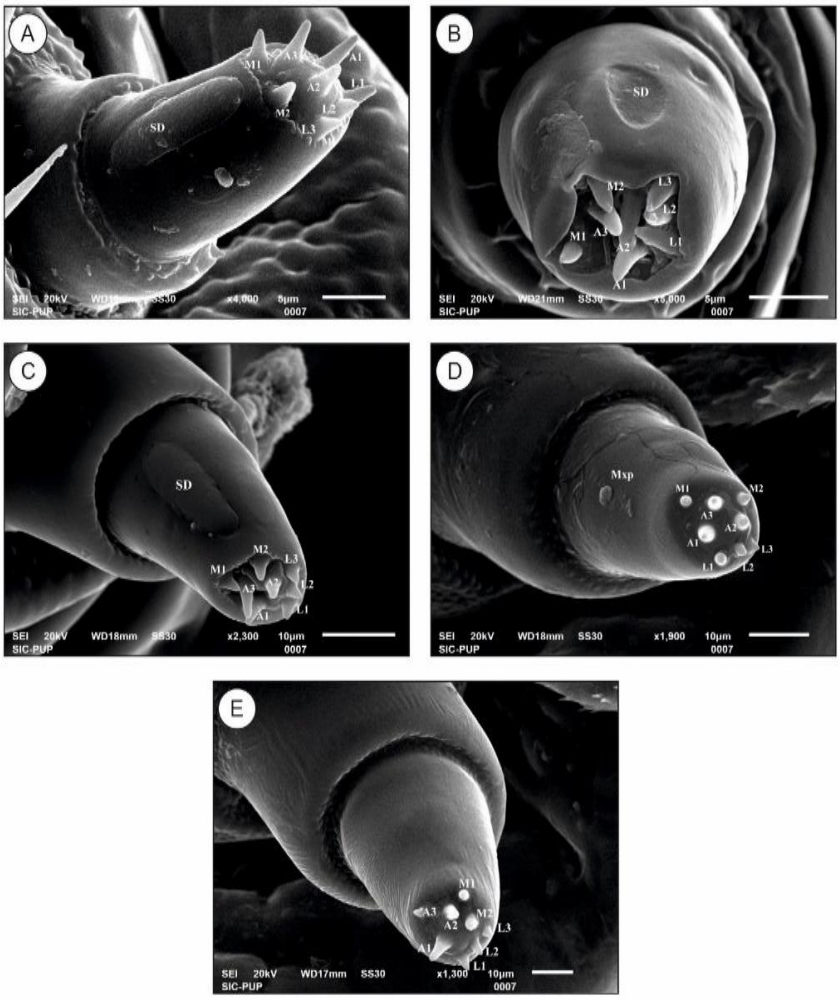

FIG. 4 : Morphology and structure of sensilla on maxillary palp in all larval instars of *Somena scintillans*
(A) maxillary palp of first instar (B) maxillary palp of second instar (C) maxillary palp of third instar
(D) maxillary palp of fourth instar (E) maxillary palp of fifth instar

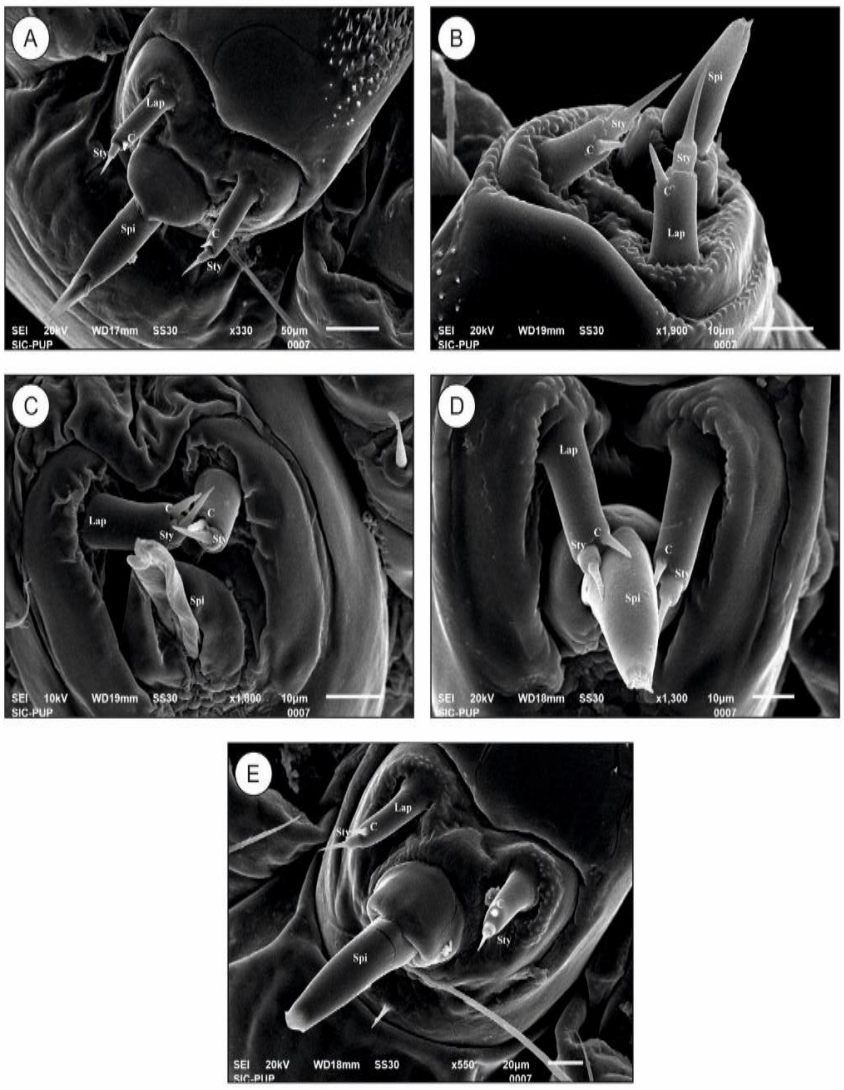

FIG. 5 : Morphology and structure of sensilla on labial palp in all larval instars of *Somena scintillans*
(A) labial palp of first instar (B) labial palp of second instar (C) labial palp of third instar
(D) labial palp of fourth instar (E) labial palp of fifth instar

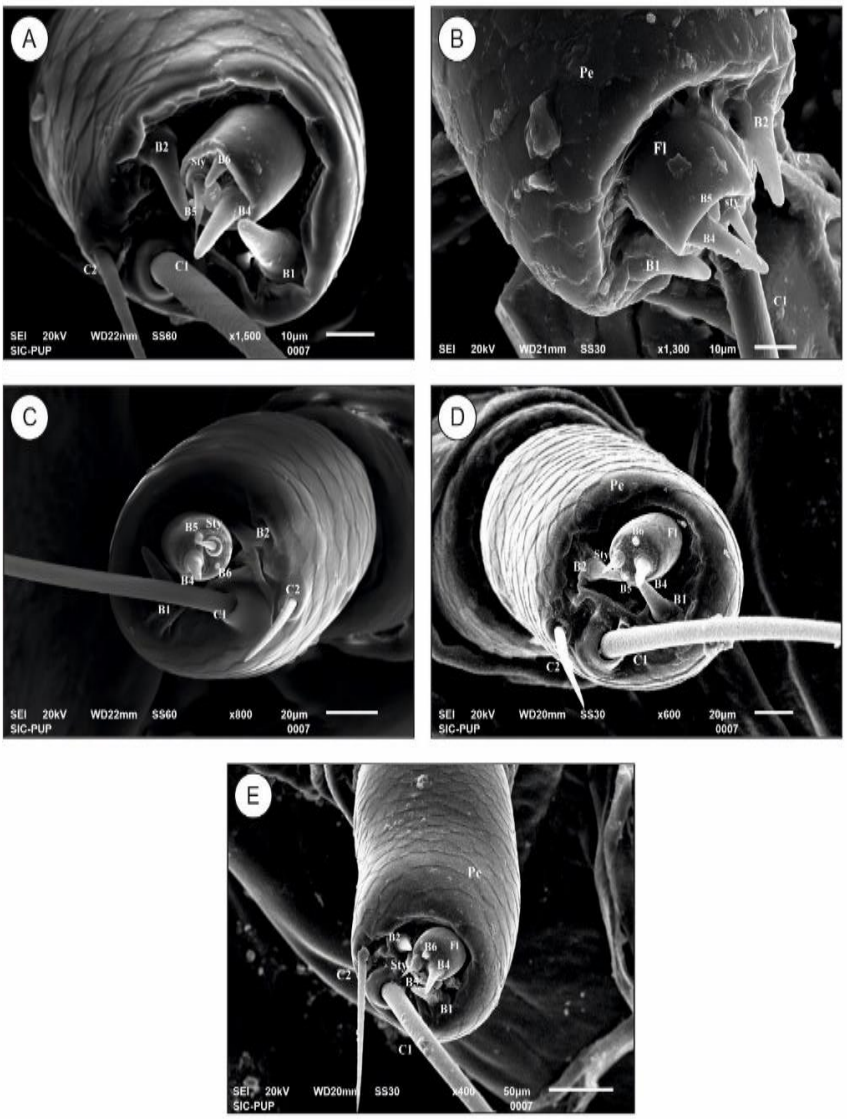

FIG. 6 : Morphology and structure of sensilla on antennae in all larval instars of *Trabala vishnou*
(A) antenna of first instar (B) antenna of second instar (C) antenna of third instar
(D) antenna of fourth instar (E) antenna of fifth instar

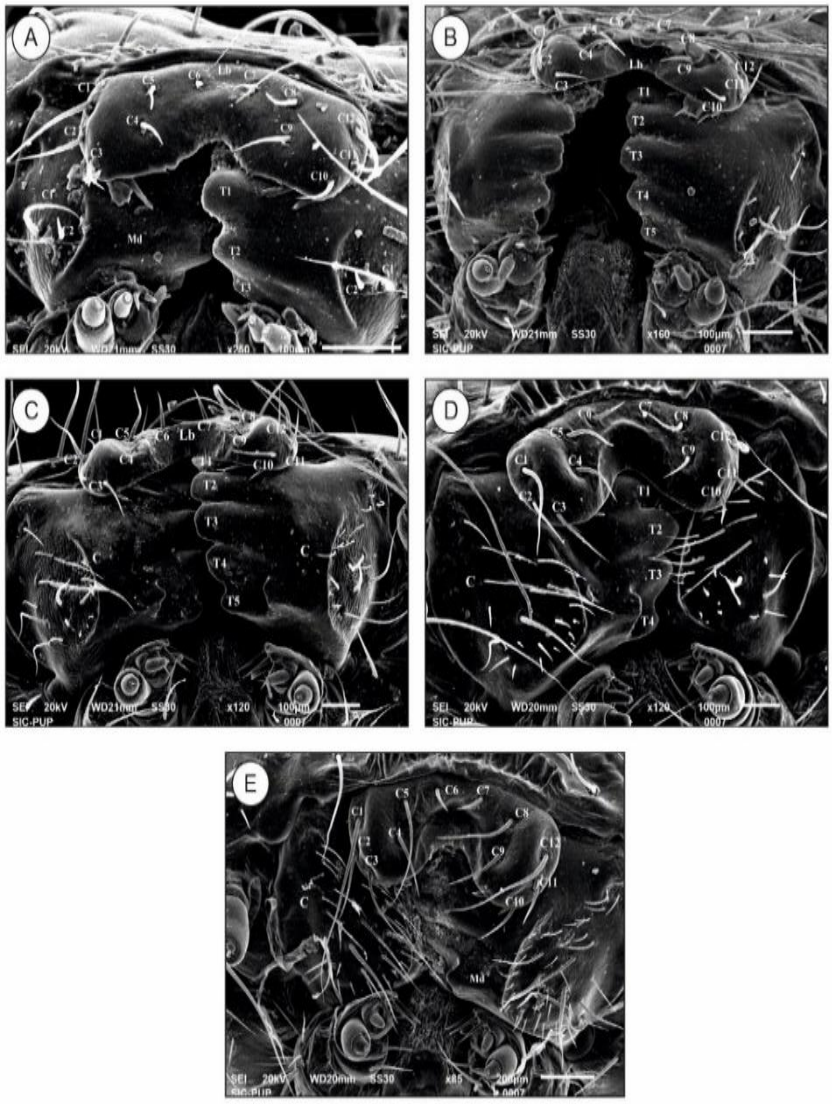

FIG. 7 : Morphology and structure of sensilla on labrum and mandibles in all larval instars of *Trabala vishnou*
(A) labrum and mandibles of first instar (B) labrum and mandibles of second instar (C) labrum and mandibles of third instar
(D) labrum and mandibles of fourth instar (E) labrum and mandibles of fifth instar

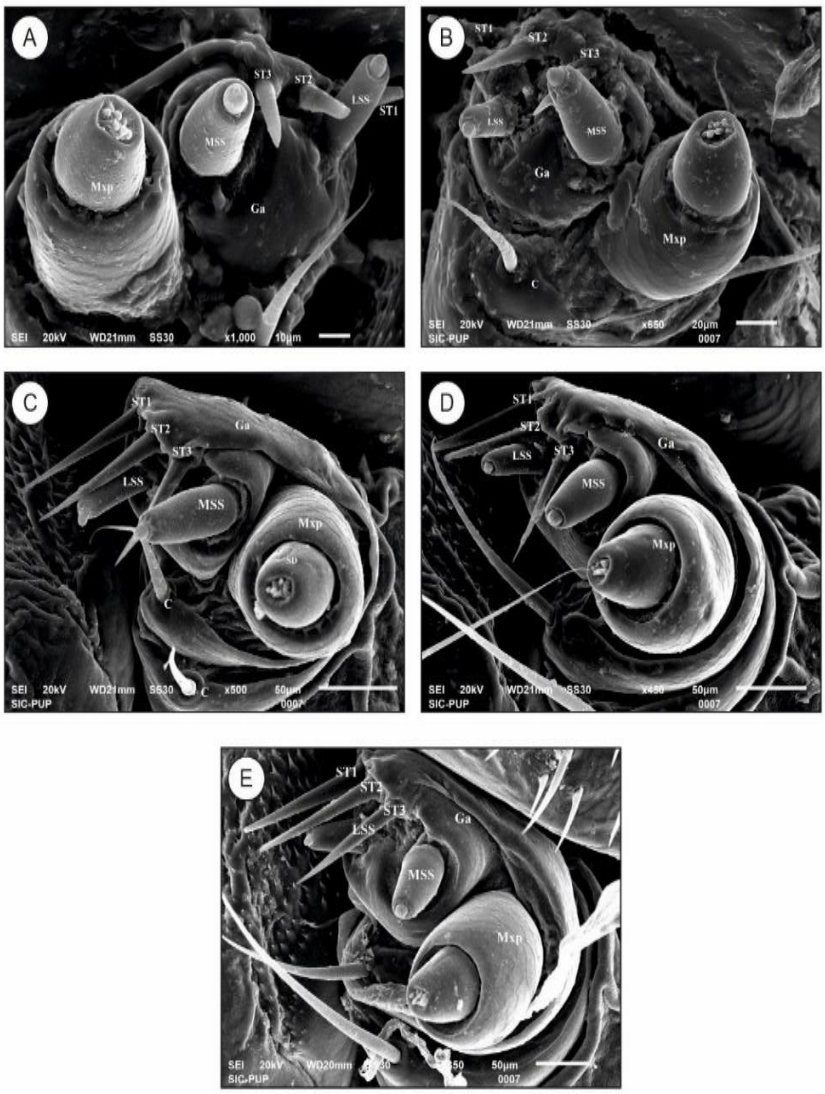

FIG. 8 : Morphology and structure of sensilla on galea in all larval instars of *Trabala vishnou*
(A) galea of first instar (B) galea of second instar (C) galea of third instar
(D) galea of fourth instar (E) galea of fifth instar

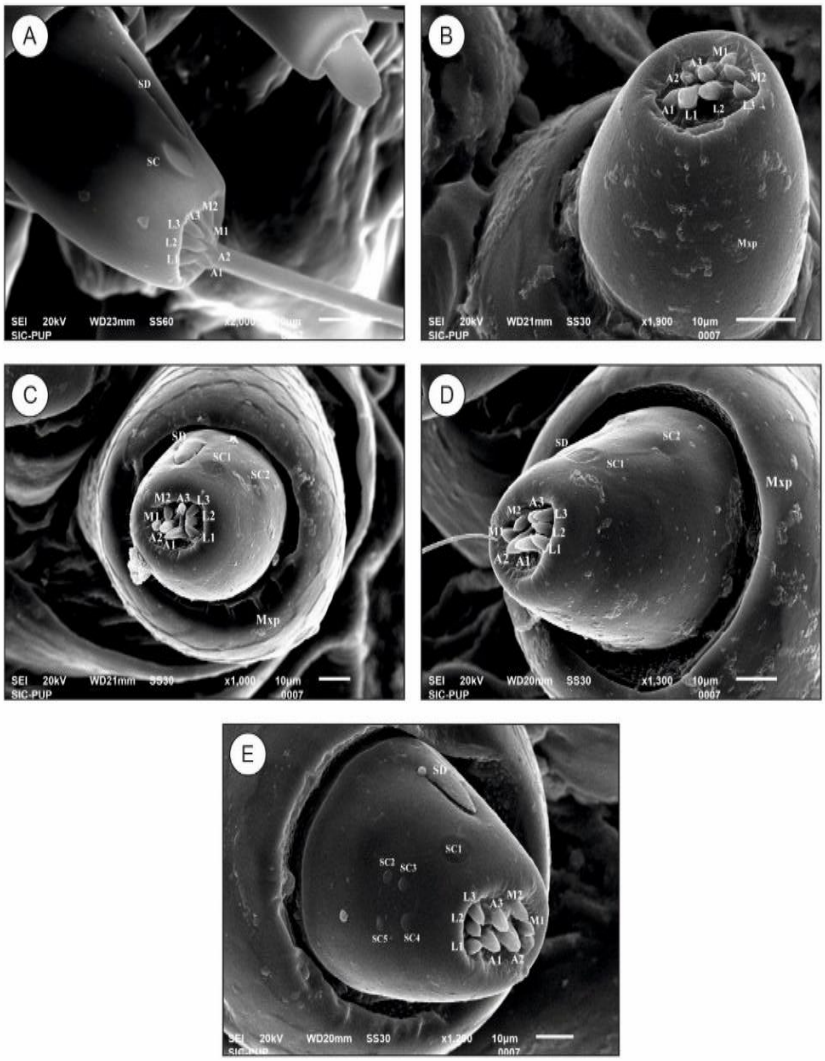

FIG. 9 : Morphology and structure of sensilla on distal segment of maxillary palp in all larval instars of *Trabala vishnou*
(A) maxillary palp of first instar (B) maxillary palp of second instar (C) maxillary palp of third instar
(D) maxillary palp of fourth instar (E) maxillary palp of fifth instar

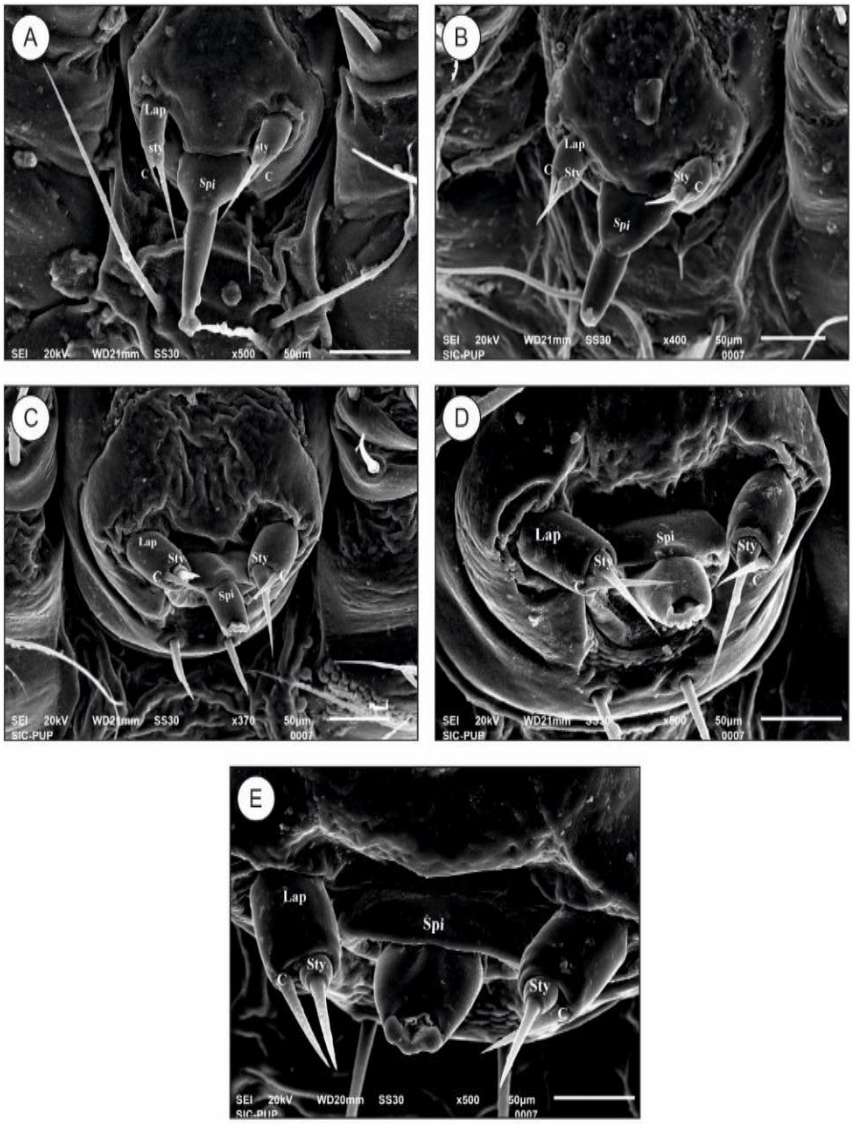

FIG. 10 : Morphology and structure of sensilla on labial palp in all larval instars of *Trabala vishnou*
(A) labial palp of first instar (B) labial palp of second instar (C) labial palp of third instar
(D) labial palp of fourth instar (E) labial palp of fifth instar